Brault, Guy, Chaput Inc.

Research Department

MICROSYSTEMS INTERNATIONAL LIMITED

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FOREWORD

In order to evaluate the semiconductor industry's prospects and Microsystems International Limited's position in it,Brault, Guy, Chaput Inc. has felt necessary to have recourse to the expert advice of Dr. T. Fancott who has done work in the field and is presently professor of computer science at Sir George Williams University. Dr. Fancott is at the disposal of our clients to answer any questions related to the overall electronic industry and to Microsystems in particular. Dr. Fancott will be of assistance in our subsequent follow-ups on the Company. Following is a resume of Dr. Fancott studies and experience in the field:

TERRYL FANCOTT, Bachelor engineering (electronic) (McGill), (Master Science (ENSA, Paris), Ph.D. (Faculté des Sciences de Paris.

Dr. T. Fancott graduated from McGill University in 1961 with a B.Eng. (Electronic) degree. After working for L.M. Ericsson in Sweden and CAE Industries in Montreal, he went to Paris in 1965 to do post-graduate work in Magnetic Logic. He received a Master's degree from L'Ecole Nationale Supérieure de l'Aéronautique, and was awarded a Ph.D. by the Faculté des Sciences de Paris in 1968. His working experience at Ericsson and CAE was concentrated principally in the fields of systems and digital design.

From 1968 to 1971 he worked for RCA Limited, where he was responsible for the research programs for the development of the prototypes of satellite experiments. In the fall of 1970, he was sent on loan to the RCA Astro Electronics Division, in Hightstown, N.J., where he designed a communication subsystem for a U.S. Air Force satellite.

He joined Sir George Williams University in the fall of 1971 as Assistant Professor of Computer Science. His research interests include Digital Communications and Medical Surveillance Systems.

I N D E X

RECOMMENDATION

Microsystems International's most important asset lies in its management which has proven its ability to operate successfully in the fast changing semiconductor industry. Through technology purchase from other manufacturers, management has broadened the Company's field of activity to take advantage of the phenomenal growth potential of the data processing equipment manufacturing industry. This provided an ideal complement to the Company's more stable business with the telecommunications industry. Over a very short period, the Company has become the world's largest producer of the fastest growing segment of the computer component market: the MOS memory integrated circuit. Relying on its own in-house research, it has also achieved a worldwide technical leadership position in the MOS field by introducing, in December 1972, in advance of all its competitors, the next generation of computer memory devices.

Once Microsystems' operations are profitable, very rapid earnings growth is foreseen. In the current year, earnings per share are estimated at $0.45 compared to an expected loss of $0.90 in 1972. Based on the success we anticipate for the Company's new computer memory device, earnings per share in 1974 could show a further substantial gain to $0.90.

Given Microsystems' proven management ability, the leadership position it has achieved in the MOS field and the rapid earnings growth expected for the foreseeable future, we feel the stock warrants a multiple of 25 to 30 times projected earnings. U.S. companies of comparable quality and prospects, sell at multiples of 30 to 40 times estimated earnings. On the basis of our 1974 projected earnings, the stock could appreciate to the mid-twenties over the next eighteen months.

SUMMARY AND CONCLUSION

Following an incubation period from 1969 to 1971 during which Microsystems has laid down the bases for its future expansion, the Company entered a new and rapidly expanding area of the semiconductor industry: the MOS memory market. Through a technology purchase from INTEL, backed by in-house development and production work, Microsystems started production of the popular MOS 1024 bit memory integrated circuit. The market for this device is growing beyond all industry predictions as computer manufacturers are switching from their traditional memory technology to this product for the new generation of computers. Microsystems' performance in this field has been so good that it is now reported to be the No. 1 supplier of MOS memory ICs in the world. Sales are made to most of the major non-captive computer manufacturers.

In December 1972, the Company announced the distribution of the MOS 4096 bit memory integrated circuit or more commonly know in the industry as

the 4K RAM, the next generation of MOS memory device. This is more than three months ahead of INTEL's schedule, their nearest competitor. In addition, the entry into Bipolar memories and MOS calculator ICs, by means of technology purchases from Monolithic Memories Inc. and NORTEC ELECTRONICS CORPORATION, will expand its high technology product line in 1973. For that year, we forecast total sales of more than double the estimated 1972 figure of $12.5 million.

This excellent sales performance is attributable to management's policy to concentrate on the lucrative, fast growing high technology market rather than attempting to compete with industry giants for part of their traditional markets. This way, Microsystems has avoided direct competition with large American producers in a field of price eroded products. Most of the Company's competition comes from small specialized corporations such as INTEL and Mostek. Larger companies have been slow to enter the MOS market, allowing the newer concerns to solidly establish themselves in the field.

Microsystems' strategy, however, is different from its direct competitors in the MOS market. Over the past three years, it has developed a comprehensive product line including linear and hybrid circuits for the telecommunications market and high technology memory products for the data processing equipment industry. Although this move has been costly, the Company is expected to reap the benefits from it as early as 1973 when it starts to penetrate the telecommunications market with high quality hybrid products such as tone generators and telephone line switching circuits. This will give Microsystems a stability and market depth not possessed by its immediate competitors in the MOS field. It will also facilitate the future development of systems which will improve the Company's profitability and strengthen its overall competitive position. By 1975, Microsystems is expected to be a well diversified and established semiconductor and systems manufacturer.

Because of heavy emphasis on R & D in order to develop a full line of products, the Company's degree of profitability in the early stages of its development was not satisfactory. In 1970, Microsystems' first full year of production, and a difficult year for the industry, it lost $7.1 million on sales of $6.3 million. In 1971, the deficit totalled $6.4 million on sales of $9.1 million. Sales for the first nine months ended September 30th, 1972 reached $8.4 million, a 62% gain over the same period last year. The net loss for the nine months was 17.3% less than for the same period last year. This improvement continued in the third quarter; the deficit was 20.4% inferior to that suffered last year even though profitability was affected by the holiday period and some manufacturing problems. For 1972 as a whole, we expect sales of $12.5 million with the best contribution coming from the MOS line of products. Loss per share during 1972 should total $0.90 down 25% from last year's loss of $1.21.

For 1973, we anticipate sales of approximately $27.5 million as a result of large gains from the MOS, hybrid and bipolar memory lines. An order backlog of $15 million at the end of the third quarter up $8 million from

the previous quarter adds weight to our estimate. Profitability should also be up sharply as all lines, except hybrids, are expected to be profitable. In 1972, only the discrete line was profitable for the entire year. We are forecasting earnings per share of $0.36 to $0.52 for the year. The upper end of this range will be achieved if Federal government's grants are available to the Company for the whole year. We believe grants of some forms will be available, as the government is as eager as ever to have a Canadian producer within the big leaguers of the semiconductor industry as soon as possible.

Based on the success we anticipate for the Company's 4K RAM, sales for 1974 could reach $40 to $50 million and earnings per share show a further substantial gain to $0.90.

MICROSYSTEMS INTERNATIONAL LIMITED

DESCRIPTION OF THE COMPANY

Microsystems International Limited was formed in 1969 by Northern Electric Company Limited, Bell Canada's wholly-owned manufacturing subsidiary, for the purpose of providing a Canadian source of semiconductors. Semiconductors refer to the family of devices such as transistors, diodes, and integrated circuits which are used as building blocks for modern electronic products and equipment of all kinds, ranging from portable radios to highly sophisticated computers. Microsystems' shares were first offered to the public at $10 along with Bell Canada's preferred convertible shares. Assuming all outstanding options and warrants are exercised, Northern will have close to 63% of the Company's issued shares by the end of this year.

Northern felt that as in independent entity, Microsystems would be in a better position to remain at the fine edge of the latest development in the industry and could widen its market by selling to outside customers. Further, it would make the most advanced products available to Northern, provide an outside technological impetus to its own operations and allow the Company to realize economies of scale. The creation of a semiconductor industry in Canada is part of a decade-old program of the Federal government, aiming at encouraging investment in research and development in Canada. This is why the Canadian government has contributed financially to the formation of the Company.

Microsystems has inherited Northern's assets, know-how and trained personnel at its Advanced Device Centre, near Ottawa. The Company has used this base to build an enterprise to serve world demand for high quality, systems-oriented micro-electronic products. Originally, Microsystems' efforts were directed towards the telecommunications industry because of its expertise and know-how in this field. Very soon after its inception, however, it aimed to serve a wider spectrum of microelectronic users of which the data processing equipment industry is the largest and fastest growing segment. Microsystems broadened its product lines by buying the technologies from other manufacturers to take advantage of the phenomenal growth potential of these other markets

and to complement its more stable business. In a very short while, the Company is reported to have become the world largest producer of the fastest growing segment of the computer memory market: the MOS memory integrated circuit. Through in-house research, it has also achieved a worldwide technical leadership position in the MOS field by introducing recently, before all its competitors, the 4K RAM, the next generation of memory device.

The Company's manufacturing, research and development base is located in a most modern plant near Ottawa and its corporate headquarters in Montreal. In Canada, sales offices are maintained in Montreal, Ottawa and Toronto. In the U.S., seven sales offices are operated by Microsystems International Inc. of Palo Alto, California. In addition, the Company maintains either offices or sales representatives in various countries of Europe, and in Japan, Hong Kong, Australia, Israel and New Zealand. The Company also has an assembly plant in Penang, Malaysia. Present geographical distribution of sales is about 60% to the U.S., the remaining 40% being divided equally between Canada, and Asia and Europe.

MICROSYSTEMS PRODUCT MIX

The Company's marketing policy at the date of its inception in 1969 was to expand product lines inherited from Northern Electric, with a specific emphasis on service to the telecommunications industry. Since then it has enlarged its horizon to include high technology products related to the fast growing data processing equipment industry.

This evolution of basic policy has enhanced Microsystems' sales growth considerably. The full impact of this new approach will be felt for the first time in 1973, when we expect sales to more than double from the 1972 total. The Company also continues to serve the telecommunications industry and directs a considerable research effort to that area. As a result the Company's product-mix covers a much wider range than any of the other new comers to the field and, therefore, has the depth to become a major contender in the industry in only a few years.

The products fall into six categories as follows:

DISCRETE

Microsystems inherited this line from Northern Electric and continues production almost exclusively for them. Last year the line was expanded by the addition of light emitting diodes, semiconductor devices which can replace indicator lights in electronic equipment. These have been selling well since their introduction.

DISCRETE: refers to individual transistors and diodes. These are usually made using bipolar technology, the original and still most widely used semiconductor technology.

BIPOLAR DIGITAL

The Company produces a line of DTL digital integrated circuits. This is also a series of designs inherited from Northern Electric, and sales are almost exclusively to the parent company. Microsystems' management sees no reason for investing the heavy amounts necessary to launch the Company into a more competitive TTL operation, because this area is the most highly competitive and price eroded of the entire range of integrated circuits. The captive DTL production represents a good steady revenue item and does not require heavy sales or research investment. Further it provides low cost interfacing logic for the MOS memory systems that is starting to sell.

BIPOLAR DIGITAL: refers to switching circuit and logic functions such as gates and information storage elements. These are the building blocks of computers and are also used extensively in any equipment associated with computers on data processing. ICs are usually classified according to type and size. The letters RTL, DTL, and TTL refer to the different types of circuit designs used to achieve the digital functions. RTL, or resistor-transistor logic, was the first design developed. It was superseded by DTL (diode transistor logic) which is now being slowly replaced by TTL (transistor logic) the most modern and efficient design. A fourth type, ECL (emitter coupled logic) is an expensive special purpose high speed design. The size classification of digital ICs simply refers in general to the number of transistors per IC. The terms used are SSI, MSI and LSI, referring to small, medium and large scale integration respectively.

LINEAR

Microsystems' approach to the strongly competitive field of linear ICs has been to concentrate on a high reliability line of products selected to appeal to the telecommunications industry. This strategy has enabled them to side step the toughest competition taking place in the lowest price ranges and to appeal to a market where they have the greatest expertise. Linear circuit experience also represents a valuable technological support of hybrid circuit development, as they are involved in a high percentage of hybrid designs.

LINEAR: refers to integrated circuits typified by amplifiers. Their applications range from consumer products such as audio amplifiers and TV tuning circuits to industrial process control and communications devices.

HYBRID CIRCUITS

This technology represents the main thrust of Microsystems' approach to the telecommunications market. The high quality and reliability of hybrid circuitry make it an appealing product for this market and Microsystems has already had good success with two products: the ME 8000 IJ head set amplifier widely used in the new, more aesthetic head sets worn by switchboard operators; and the ME 8900 tone generator sold in sampling quantities to most of the major telephone and data processing companies in the world including L.M. Ericsson of Sweden, Bell Telephone Manufacturing of Belgium, Nippon of Japan, International Telephone and Telegraph and International Business Machines. The market potential for the tone generator device is excellent. Not only could it be adopted as the basic circuit of the next generation of push button telephones, but it may also find applications in the fast growing data communications field. A number of data processing equipment manufacturers have bought sample quantities, including IBM. Microsystems is the only non-captive producer to deliver this kind of device to date.

HYBRID: The term "hybrid" refers to the creation of circuits from a number of integrated circuits by attaching the silicon chips directly to a ceramic base onto which interconnection leads have been printed and then enclosing the whole circuit in a package resembling an integrated circuit. The technique is useful for building modules which cannot be made as a monolithic integrated circuit for reasons of circuit complexity or compatibility.

The latest and perhaps most significant telecommunication type hybrid is the crosspoint switch. This device, barely 1½ inch-square, could ultimately replace the bulky cross bar switches in electronic telephone switching exchanges. The improvement in size, cost and power consumption over the mechanical type switch is so great, that this could revolutionize telephone switching, and cut telephone plant equipment costs. The device has already been delivered in sampling quantities and the market potential appears quite considerable.

Microsystems is also experimenting with hybrid assembly of several MOS chips. This technique promises to be a very powerful and competitive technology for building systems and could give the Company a significant advantage over its competitors in this field.

A significant result in the Company's research program on hybrid circuits is the development of the MILMOUNT terminal ™*, a mounting technique which can lead to automated hybrid assembly, a great improvement over the older, manual wire bonding process. Microsystems engineers estimate that the improvement in efficiency is so significant that they expect to keep the hybrid assembly in Canada, rather than moving the operation to their Malaysia plant.

* Patents pending

MOS

Microsystems entered the MOS market strongly in 1971 with its purchase of INTEL technology to produce the 1024 bit MOS LSI memory chip. Sales are so good in this area that they are now the world's largest MOS memory supplier, with an output higher than INTEL itself. In October 1972 another high sales potential product was added with the purchase from NORTEC ELECTRONICS CORP. of a design of a four function calculator chip. This move was followed by the signing of a $5 million contract with Rapid Data of Toronto to deliver the chip for their line of hand held calculators.

MOS: MOS (metal oxide semiconductors) refers to a different technology from bipolar. Although MOS devices are based on silicon materials similar to those used in bipolar devices, their design and principle of operation allows a much greater degree of miniaturization and a much lower power consumption. These two qualities make MOS ideal for large scale integrated circuits and explain their much greater circuit density with respect to bipolar.

MOS devices have, however, other properties which are not so attractive. They require higher drive voltages than bipolar devices, have a slower response time, and were originally much more delicate. (The static electricity on a technician's hands was enough to burn out early devices.) On the other hand, the simple fact of being able to concentrate 10,000 transistors on a single chip of silicon implies such tremendous savings in digital systems production costs, that sales are assured for any successful device.

The fastest growing segment of MOS products is computer memory integrated circuit. These include Random access Memory (RAM) the traditional memory chip which information can be continuously read and rewritten, Read Only Memory (ROM) with the information permanently recorded at the factory and Programmable ROM (PROM) which information can be permanently recorded by the customer before installation in his unit. The next generation of MOS memory device is the 4096 bit memory integrated circuit commonly known as the 4K RAM.

Microsystems have also added a small computer central processing unit, the CPS-1, to their line of MOS LSI products. Although the greater part of the Company's sales in MOS are at present individual integrated circuits, Microsystems also sells memory systems, complete computer memory modules consisting of a number of MOS ICs mounted on a printed circuit board along with the necessary drive circuits. The systems approach has an attractive "added value" factor which enables the company to compete more strongly in this field and gain higher profits. Already experimental systems assemblies using hybrid circuit technology have been tested and this may lead to a very strong position in systems sales. An obvious future development is the combining of the CPS-1 central processor chip with a number of memory ICs in a single hybrid package to form a minicomputer the size of a wrist watch. The Company has the capability to do this and it would not be surprising to see an announcement to this effect in the foreseeable future.

BIPOLAR MEMORIES

Microsystems acquired its capability in bipolar memories through a technology purchase from Monolithic Memories Inc., in August 1971. Since then, it has set up production lines for a 256 bit RAM chip, and for a variety of ROM's and PROM's. Production should reach full capacity in 1973 and sales of about $2.5 million are expected. This technology is faster and easier to use than MOS, but Microsystems' management does not expect it to replace the latter because of the considerable lower circuit density of the chips. They expect sales to develop in small data processing applications. Ultimately this technology could also bring microcomputing power to consumer products, such as appliances or automobiles.

BIPOLAR MEMORIES: Parallel to the rapid development of MOS technology, improvement in Bipolar LSI techniques have advanced the level of circuit density considerably. While current designs of chips are still only 1/10 as dense as MOS devices, this technology has some very basic advantages: much higher speed, more reliability, and compatibility with the TTL integrated circuits presently used as the building blocks of all modern computers. These devices find their sales to users who require high speed, or who are building equipment with a small memory or a permanent memory. Bipolar memory products cover the full range of RAM, ROM and PROM memory types.

Although Microsystems' products cover a wide range of the semiconductor industry, their research and marketing effort is concentrated mostly on the new, high technology lines. Of these, MOS and bipolar memories are aimed for the most part at the computer manufacturers while hybrids are particularly suited to the telecommunications industry. This product-mix is an effective combination for a new-comer to the industry. It avoids head-on competition with the major producers where they have their greatest experience, and it assures the Company a fast growing market, where their expertise is equivalent, or better, than that of competitors. A further advantage is derived from the complementary characteristics of the two markets, computers and telecommunications. While the former is a fast growing but volatile market, the latter develops slowly for a new supplier, but, represents long term steady sales potential. This has a stabilizing effect on Microsystems' operations and gives them a greater security of operation than the specialized companies such as INTEL.

THE COMPANY'S STRENGTHS

As discussed in the Appendix on the semiconductor industry, the characteristics inherent to this industry are very particular and, as a result, we feel the conditions for success are three-fold:

1- Manufacturing and research management ability: management must be flexible enough to adapt the Company's technical strategy to the changing market situation. It must be able to choose the right product to aim at future market

demands, to assure that development is parallel if not ahead of the competitors, and thus, when in the production phase, enough stress has to be placed on manufacturing techniques to maintain quality and delivery schedules.

2- Financial capacity: to support costly development periods for each product and unprofitable operations at the inception of a product on the market when it is sometimes necessary to lower price below cost to capture a large share of the market. It is also important to have the financial capacity to finance investment in the most modern machinery to produce at a competitive cost and in the manufacturing facilities to handle the fast growth of a product when demand picks up.

3- Marketing competence: to plan a successful marketing strategy and overall coverage of all the accounts. The salesmen have to be highly qualified people to be able to explain the technical characteristics of the product and help the customer in solving some of its technical problems.

We are of the opinion that Microsystems International Limited has these ingredients.

Manufacturing and Research Management Ability

The Company has about 1,250 employees in a 340,000 square foot research, development and manufacturing facility in Ottawa, all equipped with the most modern high quality equipment available. The manufacturing lines of MOS products, in particular MOS memories, are being doubled to meet the forecasted $14 million in sales for 1973. This should confirm Microsystems in its present position of the world's largest MOS memory supplier. The bipolar and hybrid facilities were brought up to full production in the last quarter of 1972 and, in our judgment, this capacity is ample to fulfill our sales predictions for 1973. In addition to the Ottawa facility, it has followed the lead of the major semiconductor companies in establishing an assembly plant in Penang, Malaysia, a low labour cost area. This facility, built in May 1972, will further reinforce sales of both component and assembled memory systems.

Like most companies in the semiconductor industry, Microsystems is highly research oriented. The cost of its annual research effort exceeds $6 million, a disproportionate amount in view of the $12.5 million in sales expected for 1972 but is reasonable considering the Company's sales target of $50 million by 1974. Research expenditures, equal to about 10% of gross annual sales, are considered normal for a company in this industry. Federal government's grants have enabled the Company to make this initial effort and the rising sales curve indicates that this policy is paying off.

This $6 million of research expenditures is devoted almost entirely to product development and improvement, rather than pure research into future technologies which may be on the market five years hence. Microsystems' policy is to gain a full understanding of technologies manufacturable today and to ensure that both engineering and manufacturing personnel is well trained in them, in order to achieve high design and production efficiency. A further point of concern is the transfer of new designs from the research labs to the production line. The research labs are completely equipped so that they can develop and test production techniques in small batches on their own equipment before sending the product to manufacturing. To further ensure a smooth transfer, responsible engineering personnel are often transferred to manufacturing with the new design to monitor the start-up and to correct initial production problems.

The development of each new product comes under the supervision of a new product committee which periodically evaluates the progress of a device with respect to technology, the market and financial trade-offs. The members of the committee are drawn from the technical, financial and sales executive staff and their task is to periodically examine the relevance of each product under development with regard to technological developments in the industry, the projected market demand for the product and its earnings potential in relation to development cost. It is this committee which must evaluate whether in-house research will develop the device in time to make a market impact or whether a technology purchase will be necessary to put the Company in the market at the right time.

This decision-making process is illustrated by the three technology purchase the Company has made since its formation. The first was an agreement signed with INTEL, to second source the 1,024 bit MOS memory integrated circuit. This purchase brought the technology about 6-9 months ahead of Microsystems' in-house research capability at the time and resulted in the Company gaining a well-timed entry into the market; this will mean sales around $14 million in 1973. It is interesting to note that Texas Instruments which is considered to be one of the world's largest MOS manufacturer buys 1024 bit MOS memory integrated circuits from Microsystems.

The second purchase was made from Monolithic Memories Inc. in the form of an agreement to second source their line of bipolar Read Only and Random Access Memory integrated circuits. This technology is complementary to MOS but could become competitive if new developments improve circuit density of the ICs. Its acquisition represents, not only an addition to the product line, but also a secure foothold in the other main semiconductor memory technology. The third purchase was made from Nortec Inc. The product was the MOS four function calculator chip, the heart of the hand-held calculators now appearing on the consumer market. This purchase involved a design rather than a technology and it has enabled Microsystems to start production for a large market with a very short lead time. The purchase was followed within a week by the signing of a $5 million contract to deliver the chip to Rapid Data Systems and Equipment Ltd., an agreement which has firmly entrenched the Company as a

contender in this line.

Choice of technology is also the responsibility of the committee. They must maintain an industry-wide view of technical developments and decide if and when to enter a new market.

Having concentrated the bulk of its efforts on the fast moving, high technology sector of the semiconductor industry, the Company's sales progress depends on its ability to maintain its position in the forefront and to adopt any new technology which may threaten the dominant position of its present N-Channel MOS product line. Microsystems has the advantage of being linked through its parent company, Northern Electric, to the Bell System and thus, has access to the research results of the Bell-Northern research laboratories in Ottawa and Bell labs in Murray Hill, N.J.. The "new product committee" approach assures the Company of the flexibility needed to use this advantage if necessary, as well as to make outright technology purchases as demonstrated by the above examples.

The speed with which the Company established its position in the MOS field and its subsequent manufacturing and sales performance has clearly demonstrated the effectiveness of this type of technical administration. The in-house development of the 4K RAM, months ahead of the competition, has further confirmed the research capabilities of the Company and gives strong evidence to support the expected future performance.

Financial Resources

Microsystems' financial backing is very substantial. It is controlled at more than 60% by Northern Electric Company Limited, itself a wholly-owned subsidiary of Bell Canada. Together, these two companies have close to $4 billion of assets. Further, the Canadian government, which was instrumental in the creation of the Company, is making available to Microsystems, large amounts in the form of loans and grants.

In order to foster its goal to create a semiconductor industry in Canada, the Federal government made available $48 million to the Company. Of this amount, $12 million represent an interest free loan, while the remainder, $36 million, constitute conditional grants to be repaid if Microsystems achieves cumulative profits equal to 10% of cumulative sales. This is a very high percentage and we doubt it will be attained considering the large accumulated deficit. These loans and grants are used to buy equipment and pay for 50% of the Company's R & D and pre-production expenses. So far, Microsystems has utilized only about half of these funds and we do not think it will have used them completely by the time the deadline is reached on April 1st., 1973. We think an extension of the deadline or financial assistance in some forms will be granted, however, as the government's desire to help in the development of a semiconductor industry in Canada is as strong as ever. Further, the Company has made a very efficient use of the funds and we feel the government will be impressed by the very fact that it has not used them all before the limit when it was free to do so.

Termination of the loans and grants on the set date would not endanger the existence of the Company but would reduce early profits. Research efforts would have to be reduced in new product areas but would not affect operations in the present areas of concentration.

The Company's current cash flow and the $5 million advance due from Northern this year will be sufficient to take care of the capital expenditure program for 1973 and normal expansion beyond. If additional funds were needed for a more rapid expansion or for acquisitions of technology that could not be developed in-house, we feel the Company could easily resort to public financial markets.

Following is a condensed version of Microsystems' latest balance sheet which shows a strong working capital position and a low debt equity ratio.

Condensed Balance Sheet
as at December 31st, 1971

	($ million)		($ million)	
Current Assets	$13.3	Government interest free loan		$ 4.1
Current Liabilities	8.2	Shareholders' equity		
Net Working Capital	5.1	- issued: 5 million shares	30.3	
		- advanced from Northern	5.0	
Investment	.6	- contributed surplus	2.0	
Net Fixed Assets	17.3	- deficit	-18.4	18.9
	$23.0			$23.0

Marketing Approach

Microsystems' sales strategy ties closely with its research priorities. The products inherited from Northern Electric, such as discrete devices and bipolar digital circuits, are not promoted strongly on the open market. These products would have to face the toughest competition in a market sector which is growing slowly, whereas captive sales to Northern Electric alone assure their profitability without heavy investment.

The high technology type devices, however, are marketed aggressively, using both extensive publicity and direct approaches by sales and technical teams to sign up key accounts such as Digital Equipment Company, the second largest computer manufacturer, and Texas Instruments. Microsystems has extended this approach in its European sales effort to the extent that its president, Olaf Wolff, personnaly heads sales missions to large potential customers. The effectiveness of this approach is demonstrated by the Company's $15 million order backlog as it moves into 1973 and its list of clients. Microsystems' clients include some of the

largest companies in the world, such as UNIVAC, Digital Equipment Company, Burroughs, Hewlett Packard, Litton Industries and Texas Instruments.

Linear circuits fall between the two categories of products discussed above. Because of their low unit price, in the order of 60 cents, and the extent of competition from other semiconductor producers, they do not lend themselves to the key account approach. Sales are, for the most part, made through distributors. The demand for linears is expected to be very strong in 1973 and there may even be a shortage of these products. For this reason, we expect Microsystems will register a strong increase in this line for the first time since 1970.

The Company's original orientation towards the custom design systems for the telecommunications field has resulted in very close cooperation between the marketing, technical and manufacturing functions. Close cooperation between these different functions has permitted Microsystems to cut to a minimum the time between development of a product and manufacturing. This is an important advantage for the Company in such a fast moving industry. Since 1970, Microsystems has built up a highly competent sales team, recruiting experienced staff from major U.S. semiconductor manufacturers. The Company's sales network covers the principal markets in the world with seven sales offices in the U.S., one in Belgium, United Kingdom, Germany and two of the largest Japanese companies as agents for Asia; Mitsubishi Corp. and Mitsui & Co. Ltd. Microsystems is making a strong effort to penetrate the rapidly growing European market but it will take at least another year before results are significant. European equipment manufacturers are about 15 months behind North Americans in their use of MOS, while market development for hybrid circuits which appeals to the telecommunications market is always slow.

PAST OPERATING PERFORMANCE

Since the beginning of the Company's short history, sales and gross margin before depreciation have steadily improved (See Table 8 at end of this report). From 1969 to 1971, gross margin has increased from 18.7% to 46.0%. while sales have practically doubled. Pretax earnings, however, have continued to be depressed because of the Company's efforts to gain a foothold on world markets and develop new products. In 1970, the loss amounted to $1.86 per share due to bad industry conditions and heavy R & D expenditures. It is only in February 1971 that Microsystems, under licence from INTEL CORP., began shipping P-Channel MOS RAMS and shift registers. By June of the same year, the popular 1024 bit RAM began coming off its production lines and now the Company is the world's largest MOS memory supplier, surpassing even INTEL itself in 1024 bit memory output.

SALES FORECAST FOR 1972 and 1973

Excluding resale of products purchased from other manufacturers to Northern, sales for the first nine months of 1972 were $8.4 million, up 62% from the previous year. Sales for the period were affected by a slow third quarter attributable more to a lack of production capacity than market softness as Microsystems finished with a backlog of $15 million, compared to $6.9 million at the end of the first half. We expect fourth quarter sales to be around $4 million, a record high for this Company. This will result in sales of $12.5 million for the year as a whole. The major contribution will come from MOS sales which are expected to grow from $1.7 million in 1971 to $6.0 million. This increase reflects the first full year of production of this line (deliveries started in June, 1971) and the increasing market demand for the Company's products. Bipolar memories which were in a start-up phase will add $500,000 to sales in 1972.

In 1973, sales should increase sharply to $27.5 million as the Company benefits from expanded MOS production facility to fill its growing order backlog (See Table 9).

We expect MOS memory sales to more than double in 1973 and reach $14.0 million. The addition of the MOS calculator chip and the 4K RAM to the product line, will further boost sales of MOS, due to the strong market for the former, backed by the $5 million contract with Rapid Data and "field test" sales of the latter. Hybrid sales are estimated at $3.0 million up from $0.5 million, the large percentage increase reflecting the fact that 1973 will be the first full production year.

TABLE 9

ESTIMATED SALES DISTRIBUTION
OF MICROSYSTEMS PRODUCTS
Dollars in Million

	Actual		Forecast	
	1970	1971	1972	1973
MOS	-	1.7	6.0	14.0
Bipolar Memories	-	-	0.5	2.5
Hybrid	-	0.2	0.5	3.0
Linear	0.8	1.5	1.5	2.5
DTL	1.4	1.5	1.5	2.5
Discrete	2.4	2.5	2.5	3.0
Manufactured Sales	4.6	7.4	12.5	27.5
Resale to Northern*	1.7	1.7	nil	nil
Reported Sales	6.3	9.1	12.5	27.5

* Resale of products purchased from other manufacturers.

This year will be the first full year of production for bipolar memories. Considering the lack of capacity for this line in the industry and the Company's own situation of ample capacity, we think it is reasonable to expect sales of $2.5 million for this line in 1973. Linear sales will also increase, reflecting a shortage of supply for this product. Firm prices and full capacity production should give linear sales of $2.5 million for 1973.

Discrete circuits, sold almost exclusively to Northern Electric, are expected to rise moderately to the $3.0 million level in line with Northern's increased requirements. Sales of digital circuits (DTL) which have also been made to Northern up to the present time will rise to $2.5 million on account of their increased use in memory system boards.

MARGINS AND PROFITS EXPECTATIONS FOR 1972 and 1973

Although we expect some forms of government grants to continue during 1973, we have assumed, for the sake of conservatism, that they will be available only for the first quarter of operations. All figures discussed in this section can be found in Table 8 at the end of this report. For 1972, we expect that the Company's gross margin will be around 52.0% down from 54.7% in the first half, as a result of somewhat lower profitability in the third quarter. This margin should increase further in 1973 as greater volume permits the Company to go down further on its learning curve and operate at a profit in all its product lines except hybrid. This will be a market improvement over 1972 when only the discrete line was profitable for the year as a whole. Linear and MOS became profitable at the end of the year. The Company's main concern in 1973 will be to continue to increase its capacity to meet demand without jeopardizing the efficiency of its production. Early this year, the doubling up of the MOS facility will be completed and new equipment should be installed to clean up bottlenecks in hybrid production. Bipolar memory production will also be expanded as it will reach capacity early in 1973. The concern shown by the technical management for manufacturing would indicate that this operation should proceed smoothly.

An improvement to 56% in gross margin over our estimate of 52% for 1972 is small compared to the improvements in previous years. This is due to the expansion of the Company's manufacturing facilities and the coming on stream of many telecommunication products.

We expect depreciation expenses to be around $2.3 and $2.7 million for 1972 and 1973, respectively. Depreciation expenses should not grow as fast as gross plant because the rate of depreciation will be down slightly from previous year in order to better reflect the life expectancy of new manufacturing machinery and equipment. Capital expenditures, in both years, should be around $5 million. In 1972, major expenditures were made to establish bipolar manufacturing facilities, start-up hybrid production, double MOS capacity and build the Penang plant. In 1973, major capital expenditures will be directed to further expand MOS, bipolar and hybrid facilities.

We do not expect a large increase in administrative and general expenses as management continues to keep a very tight control on these costs. For 1972, we estimate these costs should be up 4% to $1.7 million. In 1973, however, we anticipate a sharp increase to $2.2 million or 8.0% of sales.

In the future, we expect marketing expenses to increase more in line with sales growth because, as these grow, a greater percentage will be handled through representatives paid on a commission basis. In 1972, we see marketing expenses rising 25% over 1971 to $2.5 million, compared to a sale gain of 37%. In 1973, with sales more than double the level of 1972, marketing expenses should be around $3.3 million or 12% of sales.

We estimate Microsystems will pay $200,000 in royalties in 1972 and $400,000 in 1973 to Monolithic and NORTEC. Interest expenses should be in the order of $200,000 in 1972 and $150,000 in 1973. We are forecasting lower interest expenses because the Company will rely less on bank loans as it will be able to finance part of its operations through its cash flow this year.

In 1972, we think Microsystems will have spent less on R & D and preproduction expenses than in 1971 as less emphasis is put on product development and more on expansion of manufacturing facilities. These expenses should be around $10 million, down from $12.8 million in 1971. Of this amount, $5.2 million will be paid by the Federal government. For 1973, assuming the government grants are terminated, we see R & D and preproduction expenses of around $4 million and $1 million respectively for a total of $5 million or half of the estimated amount spent in 1972. At the $4 million level, research expenses represent 14.5% of sales. Because of its size it is normal for the Company to spend in R & D a larger proportion of its sales than the industry average. The Federal government should pay $650,000 of these costs since the grants will be available during the first quarter.

For 1972, we foresee a loss of around $5.2 million for a pretax margin of minus 42%, a 50% improvement over last year. In view of the large accumulated deficit which will be around $23.5 million at the end of 1972 the Company is not expected to pay income tax before 1976 at least. Based on the average number of shares outstanding during the year and including Northern's advance as issued shares, this would result in a loss per share of $0.90. For the first nine months, the Company's loss per share amounted to $0.67 per share.

For 1973, assuming government grants are terminated, we expect profits before tax of $2.3 million which means a profit per share in the order of $0.36 and a pretax margin of 8.3%. Assuming the Federal government grants are continued, we estimate profits before tax could reach $3.2 million or $0.52 per share. We are using the mid-point of this range for our 1973 estimate.

A BRIEF LOOK AT 1974

The most successful company to date in the MOS field has been INTEL CORPORATION. By being in the lucrative memory system board market for a year and through the early introduction of its 1024 bit MOS memory integrated circuits, it has been able to take orders at very high prices and realize a pre-tax profit margin of 17% for the first nine months of 1972.

Microsystems is just entering the memory system board market and will be first with the new 4096 bit MOS memory integrated circuit for delivery early in 1974. The outlook for profitability and sales next year depends greatly on the success it will have with its 4096 bit MOS memory. At this early point, we think sales could reach $40 to $50 million for 1974; we will of course, have a better idea of the demand for the 4096 MOS bit memory after the first half of 1973 as the Company gets the feedback from field tests.

Because Microsystems' lead time of three months in the introduction of its 4096 bit memory system is shorter than INTEL's six month lead in the introduction of its 1024 bit MOS memory and because the Company's product mix is more diversified, we do not think it could achieve the 17% margin enjoyed by INTEL. We feel a level of 13%, however, is quite reasonable to expect. On that basis, 1974 earnings could reach $0.90 a share.

P/E COMPARISON

It is difficult to make any direct meaningful P/E comparisons with other semiconductor manufacturers as none exists in Canada and those in the U.S. differ widely, either because of their size, product mix, research/manufacturing orientations or corporate strategy. Following is a table showing the companies' product mix, ball park estimates for 1972 and 1973, most recent prices of their shares and price earnings ratio.

	Product Mix	E.P.S. 1972(E)	E.P.S. 1973(E)	Recent Price	P/E 1973(E)
Texas Instruments	45% Semiconductors (65% ICs) 55% Government, Metallurgical, Electrical & Service	$4.00	$4.75	$175.	37
Fairchild Camera & Instruments	70% Semiconductors 30% Federal & Commercial Systems	$1.15	$1.75	$ 51.	29
Motorola	30% Semiconductors (40% ICs) 70% Consumer Products, Communication, Government, Auto Equipment	$3.60	$4.25	$130.	31
National Semiconductor Corp.	100% Semiconductors (primarily ICs)	(actual) $0.59 (May/72)	$0.85 (May/73	$ 34.	40
American Microsystem	100% Semiconductors (primarily MOS)	$0.35	$1.25	$ 16.	13
Mostek Corp.	100% Semiconductors (primarily ICs)	$0.55	$0.90	$ 35.	39
Intel Corp.	100% Semiconductors (primarily MOS)	$0.75	$1.25	$ 52.	42
Microsystems International Ltd.	100% Semiconductors (70% ICs)	($0.90)	$0.45	$ 12.	27

It is apparent from this Table that all the companies in this industry are selling at multiple above the 30 level, apart from American Microsystem, one of the largest MOS manufacturers. The lower multiple, in the case of American Microsystem, is attributable to the Company's small research efforts, heavy sales emphasis on custom MOS which do not lend themselves to large economies of scale and to a credibility gap that seems to have developed between management and financial analysts lately.

We believe the companies most closely comparable to Microsystems are Mostek Corporation and INTEL CORPORATION. All others have sales in excess of $60 million for 1972. INTEL's sales should be around $20 million in 1972. INTEL's high P/E is warranted by its leadership position in the industry. The Company is headed by Dr. Noyce, the founder of Fairchild's ICs division and regarded, by the industry and the financial community, as one of the top man in the industry. The company is reputed to have an extremely good research/manufacturing balance within the industry. Mostek Corporation, formed by ex-men from Texas Instruments at the very end of 1969, has come up to the profitability level extremely fast because of its manufacturing ability. Microsystems has not been able to reach the profitability level as fast as Mostek because of its initial orientation toward the telecommunications industry and its heavy emphasis on product development but it has now developed a line of products for the computer industry which should come into full production in 1973, thus giving the Company faster growth possibilities.

Given Microsystems' proven management ability, the leadership position it has achieved in the MOS memory field, its more stable product mix and the rapid earnings growth expected for the foreseeable future, we feel the stock warrants a multiple of 25 to 30 times projected earnings.

WARRANTS

There are 430,000 warrants outstanding, exercisable at $13.50 per share until April 1st., 1979. Following is a table illustrating the theoritical value of those warrants at various market price for the stock and using rates of discount representing the investors' expected return at which the price of exercise has been discounted in order to arrive at its present value.

	PRICE OF STOCK								
Investors' Expected Return	$10.00	12.50	15.00	17.50	20.00	22.50	25.00	27.50	30.00
14%	$ 3.00	5.50	8.00	10.50	13.00	15.50	18.00	20.50	23.00
12%	$ 2.40	4.90	7.40	9.90	12.40	14.90	17.40	19.90	22.40
10%	$ 1.60	4.10	6.60	9.10	11.60	14.10	16.60	19.10	21.60
8%	$ 0.80	3.30	5.80	8.30	10.80	13.30	15.80	18.30	20.80
6%	nil	1.40	4.90	7.40	9.90	12.40	14.90	17.40	19.90

From the above table it is apparent that Microsystems' warrants at $6.00 are overvalued relative to the current price of the stock ($12). It must be remembered, however, that the above is purely a mathematical exercise. Further as we anticipate a substantial appreciation in the price of the stock over the next eighteen months the price of the warrant is also expected to rise materially. The current large premium on the warrants clearly reflects that expectation.

APPENDIX

APPENDIX

THE SEMICONDUCTOR INDUSTRY

BACKGROUND

In 1972, total worldwide sales of the semiconductor industry are expected to exceed $2.7 billion, of which $1.3 billion represents the U.S. market alone. Products manufactured by this industry range from transistors and diodes, now familiar to the layman through their use in all consumer electronic products such as radios and T.V. sets, to highly sophisticated monolithic integrated circuits. These latter devices, which represent the forward edge of semiconductor technology, consist of arrays of thousands of transistors diffused and etched on a tiny chip of silicon no more than one eighth of an inch square. They find their application in advanced data processing and communications equipment. This sales record is remarkable for an industry only twenty five years old, and is in large part due to the breathtaking rate of advance of technological development which has taken place since its founding.

The semiconductor industry was founded upon the invention of the bipolar transistor in 1947 by scientists of the Bell Labs in Murray Hill, N.J.. Because the transistor could reproduce the functions of electron tubes with much lower power consumption, and required much less space, it rapidly made inroads into many applications in electronics, and has now virtually replaced tubes in all new equipment. By its very nature, a transistor can be easily mass produced, and successive improvements in manufacturing methods since its invention dropped the price of individual units radically. An example of this price erosion can be seen in Table 1 which illustrates the average price of silicon transistors from 1954 to 1972.

Between 1954 and 1972, the average price of silicon transistors dropped from $24. to $0.30. This price erosion was, however, compensated by a rapid increase in volume, such that the dollar sales volume increased from $400 thousand to $294 million over the same period of time. The decrease in cost and increase in reliability of electronic products resulting from the switch from tubes to transistors opened vast new markets in both consumer and industrial areas. Examples range from portable radios, which hardly existed before transistors, to computers, which in the days of tubes, were huge inefficient devices with repairmen in constant attendance. The price erosion in this market is therefore one of the basic factors contriburing to its explosive growth, rather than a constant threat to the viability of

TABLE I

	Silicon Transistors		
Year	Units 000,000	Average Price/Unit	Total Market $000,000
1954	.02	$ 23.95	.4
1955	.09	20.44	1.8
1956	.42	19.94	8.3
1957	1.00	17.81	17.8
1958	2.10	15.57	32.7
1959	4.80	14.53	69.7
1960	8.80	11.27	99.1
1961	13.00	7.48	97.2
1962	26.60	4.39	116.7
1963	50.60	2.65	134.0
1964	118.10	1.46	173.4
1965	274.50	.86	236.0
1966	487.20	.64	311.8
1967	489.50	.58	283.9
1968	684.10	.44	301.1
1969	934.50	.37	345.7
1970	786.90	.38	299.0
1971	802.70	.33	264.8
1972(E)	980.00	.30	294.0

* Source: Electronic Industry Association
(E): Brault, Guy, Chaput's Estimates.

the industry.

Monolithic integrated circuits first appeared on the market in significant quantities in 1964. New developments in manufacturing techniques had led semiconductor engineers to experiment with the fabrication of more than one transistor on a single chip of silicon. The next step was to interconnect these transistors creating a complete circuit on a single silicon chip. The first such integrated circuits produced were not very complicated. They represented usually a single circuit function, such as an operational amplifier as used in process control on communications equipment or a logical gate or storage element for computer circuitry. Their price was high, in the order of $18 per unit, compared with transistor prices which were about $1.50 per unit at that time. Nevertheless, they were competitive even at that price, because they not only represented several transistors and other circuit elements, but they also considerably reduced interconnection costs. From their date of introduction to the present day, sales of integrated circuits have risen rapidly, while prices have dropped even more dramatically than in the case of transistors as can be seen from Table 2.

Not only have mass production techniques lowered the cost of producing the individual circuit chips, but improvements in manufacturing precision have made it possible to incorporate more and more functions in the same area. Typical cost of a chip with a single circuit function in 1964 was $18.50. The average chip in 1972 has eight functions and costs $1.00. This represents a drop in price per circuit function of a factor of 180, from over $18 to twelve cents. As in the case of transistors, this drop in price had a significant effect in the opening of new markets. The dollar sales volume since 1964 in the U.S. alone has passed from $40 million to a predicted total of close to $600 million in 1972.

TABLE 2

Monolithic Integrated Circuits

Year	Units 000,000	Average Price/Unit	Total Market $000,000
1964	2.2	$ 18.50	40.7
1965	9.5	8.33	79.1
1966	29.4	5.05	148.4
1967	68.6	3.32	227.7
1968	133.9	2.33	311.9
1969	253.6	1.67	423.5
1970	300.0	1.44	432.0
1971	361.4	1.22	440.9
1972(E)	571.0	1.00	571.0

* Source: Electronic Industry Association.
(E): Brault, Guy, Chaput's Estimates.

During the last 10 years, the industry has seen not only the improvement in the technologies and precision of manufacture, but also the flourishing of a multitude of new technologies. Because of these particular conditions, the definition of a successful semiconductor manufacturer is a company which is able to invest in research to a sufficient extent to keep pace with these developments and which also has the management foresight to choose which of the new technologies will gain the greatest acceptance by the users, hence give the best market volume.

A further result of the rapid technological advance has been the creation of favourable conditions for the start up of new companies, in spite of the very formidable competition that the established ones represent.

None of the major producers has been able to, or has chosen to invest in all the new technologies to the extent that they can fill the market demand. As a result, many new companies formed specifically to exploit these gaps have been successfully established and some, such as INTEL and Mostek, have grown rapidly by concentrating on high technology products.

PAST GROWTH AND PROSPECTS

This year, for the first time since 1969, the semiconductor market experienced very strong growth. Total sales in the U.S. were $1,449 million, beating the previous record established in 1969, before the recession years of 1970-1971. This growth is expected to continue at about 15% until 1976 when U.S. sales are predicted at $2,142 million. Reasons for the boom, which is expected to be more durable than previous cyclical growth in the semiconductor industry, are new applications coming on stream, made possible by the technological advances and price reductions in the industry. Computer memories, automobiles, home entertainment equipment and wristwatches are examples of these applications predicted for 10 years but only now representing a significant market.

General growth trends since 1967 are illustrated by the following table. Overall growth, from that date until the present, has been about 33% but this figure covers the recession years of 1970-1971 which saw a 15% drop from the 1969 sales high. The 1972 surge in sales thus represents an increase of over 23% in one year and is considered to be indicative of a trend rather than a recovery phenomenon.

TABLE 3

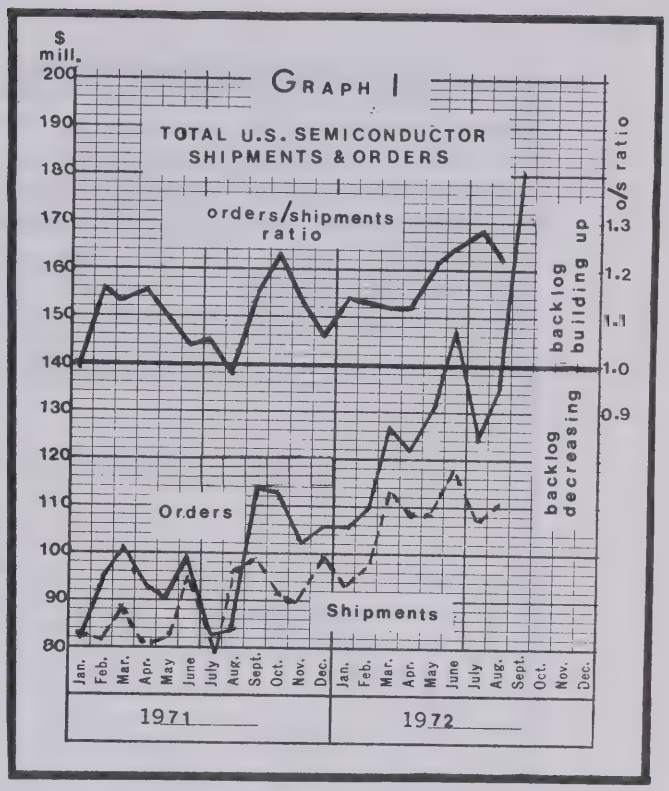
USA Factory Sales of Semiconductors*

(Dollars in Millions)

	1967	1968	1969	1970	1971	1972	1973E	1976E
Monolithic ICs	$ 228	$ 312	$423	$ 433	$ 456	$ 618	$ 768	$ 1176
Digital ICs	182	246	337	293	249	310	331	350
Bipolar Memories	-	-	-	-	13	29	62	158
MOS Memories	-	6	14	61	20	32	55	150
MOS other					93	118	150	300
Linears	46	60	72	79	91	130	170	218
Discrete Devices	810	800	905	686	623	725	745	750
Hybrid Circuits	52	64	84	91	93	106	125	216
Total Semiconductors	1,090	1,176	1,412	1,210	1,172	1,449	1,638	2,142

* Source: Electronics/Jan. 4,1973
(E): Figures for 1973/76 are Brault, Guy, Chaput Inc.

As can be seen on Graph I, the latest available figures on semiconductor orders and the ratio of orders to shipments, which are both at a record level, show the continuing strength prevalent in the industry.



Growth has been most pronounced in the area of monolithic integrated circuits, which passed from $228 million in 1967 to $618 million in 1972, a rising curve which was not significantly affected by the recession years. The most remarkable record in this sector was the performance by MOS semiconductors, whose sales have grown, since their introduction to the market in 1968, from $6 million to $150 million in 1972. This rapid growth is expected to continue, with 1976 sales projections being in the $450 million range. Table 3 shows a healthy market situation for linears, whose sales topped $130 million in 1972 and are expected to increase to $170 million in 1973. The market for these devices is expected to be so strong that industry shipments will probably be limited by production capacity.

Sales of bipolar memories are starting to make an impact on the market, rising from $13 million in 1971 to $29 million in 1972. This figure is expected to double to over $60 million in 1973 and reach $158 million by 1976. Hybrid circuits represent another growth area. Their upward curve was unaffected by the 1970-1971 recession and, in 1972, their sales increased over 13%. This steady growth is expected to continue with sales predicted at $216 million for 1976.

The following table shows specific growth trends by sector of the market.

TABLE 4

U.S. Factory Shipments (Excluding Western Electric and Hybrid Sales)

	1969	1970	1971	1972E	1973E	Change 1972/71	Change 1973/72
	Million					%	%
Government	$ 275	$ 244	$ 215	$ 225	$ 230	4.7	2.2
Industrial	188	197	207	250	280	20.8	12.0
Computer	326	254	208	265	320	27.4	20.0
Consumer	113	97	119	175	215	47.1	22.9
Distributor	193	165	177	245	285	38.4	16.3
Total Domestic	1,095	957	926	1,160	1,330	25.3	14.7
Export	140	165	140	155	170	10.7	9.8
Total U.S. Factory Shipments	$1,235	$1,122	$1,066	$1,315	$1,500	23.4	14.1

Source: Texas Instruments' December 22, 1972 Forecast

It should be noted that the two strongest areas of semiconductor growth are devices for the computer industry and for consumer products. Growth rates for these two sectors in 1972 are expected to be 27% and 47% respectively. The rapid increase in this area is reflected by the heavy demand for linears (aimed at the consumer sector) and MOS (used mainly in computers). For 1973, we expect the computer and the consumer sectors to continue strong and register gains of 20% and 23% respectively. Texas Instruments' forecast, Dec. 22, 1972). Worldwide sales distribution is illustrated by Table 5. The most rapid growth area outside the U.S. is

TABLE 5

World Sales Distribution of Semiconductor Market

	1970	1971	1972E	1973E	Change 1972/71 %	Change 1973/72 %
	Million					
U.S. Factory Shipments	$1,122	$1,066	$1,315	$1,500	23.4	14.1
U.S. Consumption	972	936	1,180	1,350	26.1	14.4
Europe	643	514	610	690	18.7	13.1
Asia	624	650	760	780	16.9	2.6
Rest of the World	85	86	95	100	10.5	11.1
Total World	$2,324	$2,186	$2,780	$3,070	27.2	10.4

Source: Texas Instruments' December 22, 1972 Forecast

presently the European market. Sales to this market are expected to increase from $610 million in 1972 to $690 million in 1973 and show no sign of slowing down. The Asian market is stabilizing with little growth expected for 1973 as Japan begins to face stiffer trade restrictions in the U.S. market for its products made with some semiconductor components.

In summary, the overall market growth is strong and is expected to remain so. The greatest increases are expected in the new high technology areas such as MOS and bipolar memories for the computer industry and in devices aimed at consumer products such as linear circuits. The U.S. market remains the strongest but is followed closely by the European market. Total world sales for 1973 should top the $3 billion mark.

COMPETITION

Non-captive semiconductor production in the United States is dominated by four companies: Texas Instruments, Motorola, National Semiconductor and Fairchild. (See Table 6). These four companies alone account for over 50% of total yearly production. IBM, not known as a semiconductor company, produces exclusively for its business machines division, and thus both its competitive position and its purchasing power must be excluded from any market analysis. Of the other four, Texas Instruments is the

TABLE 6

ESTIMATED 1971 SEMICONDUCTOR SALES OF THE FOUR MAJOR NON-CAPTIVE MANUFACTURERS

(Dollars in Million)

	Texas Instruments	Motorola	Fairchild Camera	National Semiconductor
U S A Discrete	$ 90	$ 140	$ 38	$ 4
U S A Integrated Circuits	77	60	68	32
Foreign Sales	103	40	18	12
Total Dollar Shipments	$ 270	$ 250	$ 124	$ 48

largest on a world wide basis with semiconductor sales of $270 million in 1971. Their total company sales, including their equipment and electronics products division and their services division were $750 million. More than half their semiconductor sales are outside the U.S., with Japan and Western Europe representing their leading market. Their production is heavily weighted towards the fast growing IC market, which now represents more than half their sales. Among the big companies, Texas is the largest MOS manufacturer, with 1971 sales of $20 million or 12% of the world market. Motorola is the second largest producer of semiconductor products and is the largest supplier in the U.S. market. In 1971, Motorola held about 18% of the U.S. semiconductor market, representing sales of $200 million. Of this figure, 30% is in integrated circuits. They are the leading manufacturers of ECL and linear circuits but have started late in MOS development and are not yet a major factor in this market. Their semiconductor production accounts for 30% of their sales and is the second largest division in the company.

The Fairchild Camera and Instrument Corporation is the third largest non-captive producer of semiconductor products. Their domestic semiconductor sales in 1971 were $106 million, representing 9.9% of the U.S. market. Added to this, is $18 million in foreign sales, bringing their total to $124 million. Their sales are weighted heavily towards ICs (70%) but of this percentage, MOS accounts for only 5% ($5.8 million). The Company is considered fairly weak in MOS, although they are making an effort to capture part of this market with added talent from outside. They are expected to do well in the field of bipolar memories because of their traditional strength in bipolar ICs and their concentration on the computer market. The company also has a Government and Commercial Systems division which accounted for about $75 million in 1971.

National Semiconductor is the fourth largest non-captive producer in the industry. While not yet the same order of size as the big three, it is growing very rapidly and is already leading Texas Instruments in sales

of linear ICs. It has maintained its rapid growth rate (50% increase in '72 sales over 1971 figures) by an aggressive pricing policy, leading the industry in price cuts in linear and TTL.

The trend towards concentration in the industry was temporarily reversed with the arrival of MOS technology on the market. The large companies were slow to adopt the new technology leaving room for many smaller companies to start up and attain profitability in this sector of the industry.

This is illustrated by a comparison of the worldwide sales positions of these four companies in MOS. (See Table 7). Microsystems is not included in the top seven largest MOS manufacturers because its sales in this sector for 1971 are estimated to have been only $1.7 million. The Company's MOS production reached capacity in 1972 only.

TABLE 7

1971 MOS ESTIMATED WORLDWIDE SHIPMENTS
TOP SEVEN MANUFACTURERS

Firm	Dollars in Million	% of total Worldwide Market
American Micro-Systems	$ 24	14.8
Autonetics	20	12.3
Texas Instruments	20	12.3
INTEL	10	6.2
Fairchild	6	3.7
National Semiconductor	5	3.1
Motorola	3	1.9
Top seven firms	$ 88	54.3
All others	74	45.7
Total Market	$ 162	100.0%

The MOS area is dominated by smaller companies, with only Texas Instruments making a strong showing. The rapid growth of the MOS market has boosted the smaller companies considerably and it is likely that a number of them will have the financial stability to maintain this position by the time the big four have succeeded in catching up in this area.

While the expansion of the MOS market opened the semiconductor industry to new enterprises, the 1970-1971 recession had a strong adverse effect on unprofitable operations. Many of the large companies cut back or eliminated their semiconductor divisions and many small companies disappeared from the market. Some of the most significant drop-outs from MOS were Sylvania, Union Carbide, Sprague, Westinghouse, GE and Philco Ford which closed down divisions because they were unprofitable. RCA cut down its effort in MOS to concentrate on CMOS where it has had some success in government and commercial applications.

The competition that Microsystems faces in the MOS market is thus not from any of the large producers but from small, high technology specialized producers such as Mostek, INTEL and American Micro-Systems. These companies were, for the most part, formed between 1966 and 1969 by spin-off groups of engineers and scientists from the large semiconductor companies. These technologists formed their companies on the basis of their expertise in the very high technology sectors of the semiconductor

market, when they could compete effectively against the large companies. Their sales strategy is usually to introduce new and advanced products on the market sufficiently ahead of their competitors to enable them to capture a significant part of the market.

The characteristics of the high technology semiconductor market are quite different from those of the more traditional lines. While some standard semiconductor products have a life cycle of over 10 years, new MOS products are not expected to last more than three years before being replaced by newer, more sophisticated ones. Some products realize their full sales potential for only 9 to 10 months. This is explained partly by the proliferation of small companies and partly by the high rate of growth of the industry. The market will stabilize in the next few years when new designs begin to meet the limitations of manufacturing equipment and perhaps also, the limitations of the MOS technology itself. The more stable rate of growth will, however, tend to put higher pressure on the smaller companies as the larger ones use their better financial backing to capture large market segments by aggressive price policies. It is only when stability occurs that Microsystems will first have to face the full competition of the industry giants. With the expertise that their technical management has shown to date and their solid financial backing, however, we predict they will have reached a size and developed a sales strength, which will have established them in a strong position. This prediction is further reinforced by the diversity of their product line which will give them a wider and more stable market than the companies specializing in MOS alone.

PROFITABILITY CONSIDERATIONS

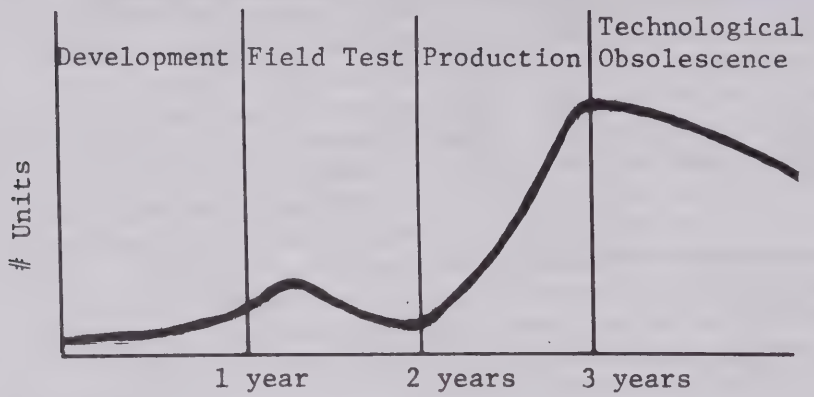
The profitability of a semiconductor company is not only linked to its technical competence and sales volume but also to its sales and product development strategy. A company with good sales in the early stages of the introduction of a product will be able to charge a high price and realize a good profit margin on the product. Later in the life of the product, competition becomes stiffer as competing manufacturers start cutting prices in an effort to capture a larger share of the market. The reasoning behind this policy is that a higher production volume entails a lower unit cost, a factor which makes large volume producers much more competitive and profitable. Semiconductor producers, especially those in the fast moving MOS market, therefore aim to introduce their products as early as possible and gain the largest possible share of the market. As illustrated below, profitability is closely related to the life cycle of a product and its relative position with the competition.

Product Cycle

The typical cycle of a product that gains wide application can be better illustrated by a graph which shows the different phases of its life:

GRAPH II

Typical Cycle of a Semiconductor Product



The first three phases last between 12 and 18 months, respectively. During the development stage, substantial R & D money is spent in order to develop successive samples of a product. During this period, small quantities of these samples are sold or given to customers for them to test and evaluate. Suddenly, a bulge in demand develops from customers who want the product to build prototypes in which the specific product is going to be used. This period of trials by prospective customers is called "the field test phase". If the product is accepted, the manufacturer will design it in the equipment. Production will, then, last for as long as the product or the equipment in which it is used does not become obsolete. The period of technical obsolescence can witness either a sharp drop in volume if the product can be replaced outright by a more advanced one or a slow decline as replacement parts are needed.

The length of the life cycle can vary for each product from one year to ten years but the typical duration of a semiconductor product that is extensively used in the computer industry is about three years. On the other hand, the life cycle of a semiconductor product sold to the telecommunications industry can be as long as ten years.

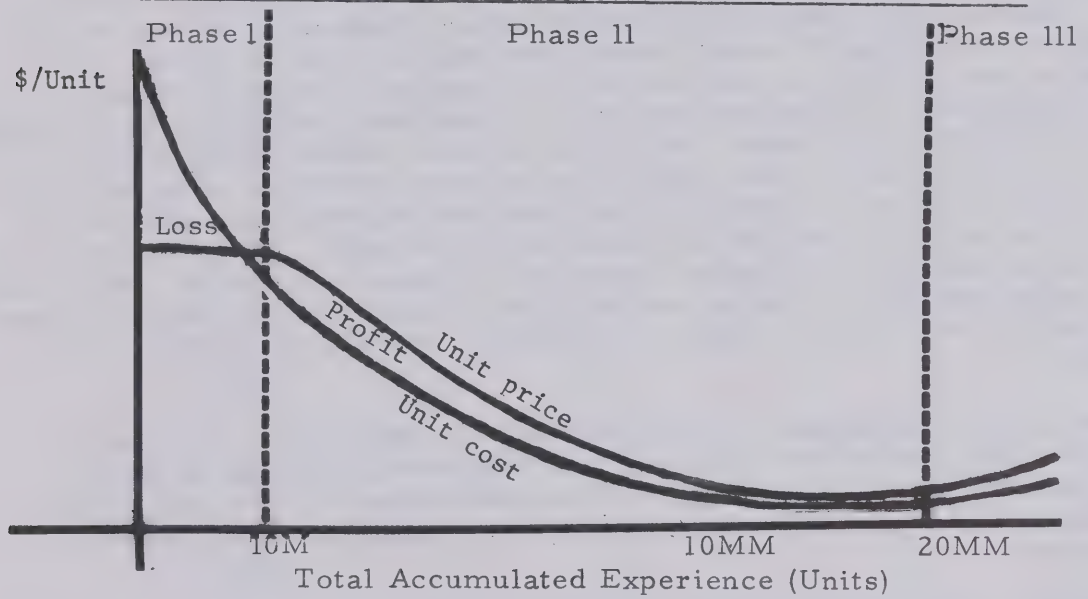
The conditions of success in this industry are to choose the right product to develop, to use research and development capacity as effectively as possible in bringing the product to the production stage and to be the first to provide samples to equipment manufacturers for field tests. If the product is accepted by a number of manufacturers, it then becomes the industry standard as it is designed in their electronic products. As volume starts building up, the producer that has the manufacturing know-how and capacity can start production on a large scale and go down its learning curve as fast as possible to keep its leadership position and take a large portion of the market.

Learning Curve

The learning curve concept is frequently used in the industry to describe what happens to unit costs as volume increases and to forecast future unit costs in order to plan the marketing strategy. In a nutshell, it can be expressed as follows: "Each time the total accumulated experience in making a product doubles, then the cost of making that product goes down a certain percentage". As volume grows, the employees who manufacture the product gain more experience and achieve a better know-how. This is especially true in the semiconductor business where production is still an art rather than a rigorous technique and where technological innovations in production processes are very fast. Larger volume also permits improvement of tooling and processes and fixed costs to be spread over more units. The following graph can better illustrate the learning curve concept and how the firm makes profits in the semiconductor industry:

GRAPH 111

Price/Cost Relationships of Semiconductor manufacturers



The Boston Consulting group which has made a study of the learning curve concept as it applies to many industries observed that unit costs generally go down 20% to 30% each time volume doubles (1). Within this range the higher the rate of technological innovations the higher the rate of technological innovations the higher is the percentage of decline in unit costs. Phase 1 corresponds to the development and the field test stage of a product when the product is tested by the equipment manufacturer at a loss in order to penetrate the market. Phase II corresponds with the production phase and usually, the start of profitable operations for the manufacturer. As it is apparent from the above chart, it is important for the company to generate large volume through pricing in order to go

(1) Perspectives on Experience published by the Boston Consulting Group Inc., 1968. Boston, Mass.

down as fast as possible on its learning curve to keep ahead of its competitors and reap profits from its operation. The company might decide to forego profits at the beginning of Phase II to capture a larger share of the market and generate more profits later as it is further down its learning curve. The goal is to dominate the market for the product along with a second source supplier and have its price low enough to inhibit growth in relative market share of any significant competitor or until the growth stops. The larger the market share, the more profits the company will make. A reliable second source supplier is very important as equipment manufacturers are unwilling to rely on a sole producer for their needs. Phase III corresponds to the obsolescence period of the product when replacement parts only are necessary. Microsystems noted recently that, during that period, unit costs go up because the low volume produces diseconomies of scale. However, companies can charge higher prices to protect their margin as only a few suppliers are left and all have approximately the same learning curve.

Sometimes, however, as it happened in the 1970-1971 economic recession, an overcapacity situation develops as demand contracts. In such an environment, semiconductor manufacturers are very fast to cut prices, thus causing heavy losses to the industry as a whole. A typical example of the relationship of the product cycle to profitability is the sales record of the 1,024 bit MOS memory integrated circuit introduced by INTEL in 1970. Because of its lead time on competition, INTEL was able to initially market this product at $35. When American Micro-Systems started to second-source it, they cut the price to $11 per unit. Now, with most MOS producers selling this device, the price is between $4 and $5. High volume sales continue to assure profitability in this line but only for those producers that have succeeded in capturing a significant share of the market.

Microsystems' management is well aware of the importance of timing in the introduction of new products. The introduction of the 4K RAM in December 1972 puts them at least three months ahead of the rest of the industry and makes it a strong candidate for adoption as an industry standard.

A further consideration which relates to product cycle is the choice of designs. There is always a risk that a new design may be superseded by a still more advanced design before it has had a chance to achieve profitability. The now classic example of this occurrence is the 256 bit chip. Introduced only nine months ahead of the 1,024 bit memory chip, it was still in the field test phase when the latter was introduced on the market. As a result, users switched to the larger design and the 256 bit chip was designed into relatively few products and never achieved a good sales record. Its effective market life was nine months to a year, compared to the three year minimum estimated for the 1,024 bit device.

Microsystems, in introducing the 4K RAM, has aimed at the natural next step in computer manufacturers requirements. The industry is not capable of producing a chip of higher density at the present time and, as a result, it promises to be a winner.

TABLE 8

Year Ending Dec. 31	Sales Am't $000	Sales Chg. %	Gross Prof. bef. Depr. Am't $000	Gross Prof. bef. Depr. Margin %	Depr. $000	Gross Prof. After Depr. $000	Adm. & G.E. $000	Mark. Exp. $000	Roy. $000	R & D $000	Pre-Prod. Exp. $000	Gov. Grants $000	Int. Exp. $000	Prof. bef. Tax Am't $000	Prof. bef. Tax Margin %	Income Tax $000	E.P.S.(1) Before Extra	Reported E.P.S. Before Extra
1969*	5,882		1,098	18.7	597	501	836	319	-	3,420	2,112	3,060	153	-3,279	- 55.7	0	-$1.26	-$1.26
1970	6,310	7	2,407	38.1	1,415	992	2,994	1,367	-	6,447	6,004	7,193	(481)	-8,146	-130.0	(1,041)	-$1.86	-$1.54
1971	9,094	44	4,186	46.0	2,041	2,145	1,636	2,055	59	6,133	6,674	6,976	198	-7,636	- 84.0	(1,233)	-$1.21	-$1.27
1972E	12,500	37	6,500	52.0	2,326	4,174	1,700	2,500	200	5,500	4,500	5,200	200	-5,226	- 41.8	0	-$0.90	
1973E	27,500	120	15,400	56.0	2,700	12,700	2,200	3,300	400	4,000	1,000	625	150	2,275	8.3	0	$0.36	
H1/71	4,142	32	2,121	51.2	962	1,159	n.a.	n.a.	n.a.	n.a.	n.a.	3,562	17	-3,694	- 89.2	(616)	$0.59	-$0.61
H2/71	4,952	56	2,065	41.7	1,079	986	n.a.	n.a.	n.a.	n.a.	n.a.	3,414	181	-3,942	- 79.6	(617)	-$0.61	-$0.66
H1/72	5,692	37	3,114	54.7	1,098	2,016	n.a.	n.a.	n.a.	n.a.	n.a.	2,178	139	-2,592	- 45.5	0	-$0.46	-$0.51

* 9 months only

(1) Based on average number of shares outstanding during the year including advance by Northern made towards fulfilling its commitment to buy 1,500,000 common shares over a 3 year period ending December 31, 1973. For 1972 and 1973, we assumed Northern will make advance for 500,000 shares in each year. For 1973, we assumed Northern's advance will be invested at a 6% return.